

Understanding Hearth Function: An Approach from Harappa



JONATHAN CODY MEYER

ARCHAEOLOGISTS FREQUENTLY EMPLOY HEARTH FEATURES as informational resources that provide charcoal for dating, charred wood, faunal material, seeds for climatic, subsistence, and waste disposal studies, and artifacts for cultural analysis. In South Asia, both archaeologists and archaeobotanists use materials obtained from hearths to contribute to our understanding of the Indus civilization (e.g., Bisht 1982; Kajale 1991; Reddy 1991; Thiebault 1988; Weber 1993). While hearth contents receive considerable attention, hearth features have garnered less interest from South Asian archaeologists. Still, differences in hearth features may relate to changes witnessed elsewhere in the archaeological record. There are many strategies that archaeologists and archaeobotanists may utilize during hearth excavation and analysis. This paper will focus on these issues by examining both traditional hearth usage in the Punjab region of Pakistan and through a detailed, though preliminary, analysis of hearths at the site of Harappa, one of the largest and most important sites of the Indus civilization (Fig. 1).

South Asian archaeologists frequently use ethnographic evidence in archaeological interpretation (e.g., Belcher 1998; Kenoyer 1998; Reddy 1994, 1997). Though explanations of the archaeological record using ethnographic analogy sometimes can be misleading, information derived from ethnographic study can work heuristically to illuminate the explanatory potentials of artifacts and their associations. Ethnographic study may present new questions or possible interpretations that otherwise might not be considered by archaeologists (Binford 1967; David and Kramer 2001). However, it should not be assumed that the behavior of humans witnessed today matches that of those who produced the archaeological record (Binford 1981; Hodder 1982). Instead, ethnographic analogy should serve to illustrate what might be possible.

This study argues that Harappan hearths differ in morphology and botanical content. Preliminary results demonstrate a correlation between hearth shape and content. Ethnographic data support the possibility that different hearth types were used for varying functions. In all of the ethnographic examples presented below, hearth shape directly corresponds to function. If hearth content and shape reflect

Jonathan Cody Meyer is a Ph.D. candidate in the Department of Anthropology, Washington State University, Pullman.

Asian Perspectives, Vol. 42, No. 2 © 2003 by University of Hawai'i Press.



Fig. 1. Selected Indus sites in Pakistan.

hearth use, future studies may be able to deduce the function of different Harappan archaeological hearth types.

ETHNOGRAPHIC STUDY

The town and villages surrounding the site of Harappa provide an excellent opportunity to study hearths. While hearth use today may not match that of Indus civilization inhabitants, domestic cooking structures from both periods share morphological features such as relative size and construction material (i.e., clay and fired brick). Additionally, cooking on ancient South Asian hearths likely had open flames employing an array of fuel types similar to their modern counterparts. Thus, study of modern hearth use makes a good starting point for archaeological hearth inquiry. In the Punjab region of Pakistan, approximately 35 homes were visited in Harappatown and the four neighboring villages. Ethnically, these inhabitants are predominantly Punjabi with some Muhajirs (immigrants from India at the time of partition and their descendants). Since there appears to be no significant difference in hearth use (or many other cultural traits) between the Punjabi and their Muhajir neighbors, both groups are referred to as Punjabis. Among the four villages visited, hearth use appeared relatively uniform. In the more urban and less spacious setting of Harappatown, residences often had fewer hearths than their village counterparts, but the hearth types and their usage remained the same. Nearly 100 hearths of four morphological types regularly used for cooking were recorded. These include the *chulha*, large *chulha*, *dudh karna*, and *kurahi*. Usually located against a courtyard wall, each type's shape serves a specific function. Although the size, ornamentation, and the material used to build the hearth can vary within a type, hearth function remains consistent with hearth type.



Fig. 2. *Chulha* with wood, chaff, and dung fuel.

Chulhas

Punjabis use this versatile hearth for heating stews, rice, tea, and a number of other foods and drinks. Punjabi residents use the *chulha*-style hearth more frequently than any other type (Fig. 2). Though *chulhas* display a wide range of stylistic attributes, each is a small, circular, open-air, mud-plastered hearth. The open side allows for the addition of fuel into a rectangular or semicircular fire pit. The type of fuel used in *chulhas* varies. Wood, specifically tree branches, has been a long term preferred fuel type because it heats quickly and burns hot. Wood, however, is a scarce and expensive resource in the Punjab; therefore it is often supplemented with animal dung when cooking. While Punjabis may utilize dung from a number of animals, including mules, goats, and sheep, the dung of water buffalo (*Bubalus bubalus*) and zebu (*Bos indicus*) surpasses all other fuels, and of these, buffalo dung is the most popular. Punjabi villagers find that using buffalo dung—a cheap and seemingly unlimited fuel source—helps to conserve wood.

Experiments testing the burning temperatures of wood (*Salvadora oleoides*), water buffalo (*Bubalus bubalus*) dung, and a wood/dung combination help illustrate the physical properties influencing Punjabi fuel use. Three 60-minute trials were conducted for each fuel type in a standard size (20-by-22-by-26 cm) *chulha*, temperature readings were taken from the top and center of the hearth at 5-minute intervals. These tests show that the burning of buffalo dung alone fails to produce the necessary temperature for expeditiously heating items placed on *chulhas* (Table 1). Certainly, a dung-fueled *chulha* would eventually boil a pot of water. However when dung supplements wood, the fuels achieve adequate flames that reach the *chulha* top and immediately heat the cooking vessel. The flame from this combination produces temperatures that often exceed or match those

TABLE I. AVERAGE FUEL TEMPERATURES FROM TOP OF *CHULHA* HEARTH (°C)

TIME (min)	DUNG	WOOD	WOOD AND DUNG
0	37.1	36.8	43.2
5	177.6	595.4	539.9
10	106.5	477.5	466.5
15	311.0	471.7	456.0
20	237.4	442.0	334.3
25	258.0	450.2	482.2
30	301.3	438.4	527.2
35	184.8	450.4	375.7
40	227.0	462.9	472.5
45	147.8	488.8	408.2
50	178.3	486.1	387.9
55	230.4	331.8	375.8
60	156.8	354.5	332.9

achieved by burning wood alone. Additionally, the wood/dung combination uses less of the regionally scarce wood resources (Meyer 2001). When Punjabi residents lack adequate wood resources, they often resort to burning leaves, chaff, or dung alone.

Large Chulhas

Punjabi villagers also use another larger version of the *chulha* for making *rotis*, a type of flat bread (Fig. 3). These hearths, three to four times the size of the *chulha*,



Fig. 3. Large and small *chulhas* as part of the same structure.

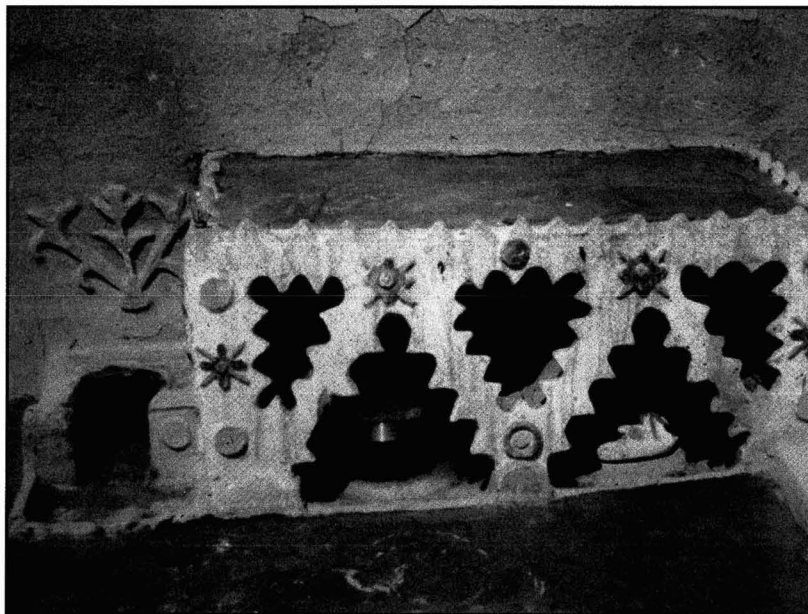


Fig. 4. *Dudh karna*, with heavy protective lid, in a decorated mud-plastered box.

share its shape and sit adjacent to these smaller hearths. While this hearth type makes it possible to cook several *rotis* simultaneously, its large size presents the problem of finding adequate fuel. Using the dung/wood combination in this type of hearth still expends a tremendous amount of valuable wood. Thus, Punjabi villagers frequently burn chaff or leaves to inexpensively obtain the desired flame. This abundant material burns at relatively high temperatures with little ash residue. Once ignited, however, these materials expire very quickly. Consequently, even short fires require substantial amounts of fuel.

Dudh Karnas

The third type of Punjabi hearth is the *dudh karna*. Used for making yogurt, the name of this hearth literally means, “milk cooker” (Fig. 4). Sometimes this type of hearth consists simply of a hole dug into the ground. Other times this type is set up within the confines of an elaborate box-shape structure. Some Punjab inhabitants claim these structures prevent animals, such as cats and birds, from getting to the milk; however, they may also serve to trap the hearth’s heat. This hearth type also exists as a portable container. In all cases, though, the *dudh karna*’s circular shape corresponds to the size of the vessel used with it.

To use a *dudh karna*, Punjabis place a ceramic milk container in the center of the hearth’s circularly arranged dung patties. Dung is the only fuel type used in this hearth. The ignited dung cooks the milk for hours. The shape of the *dudh karna* is a critical design element toward its function. Where the *chulha*’s design allows safe handling of heated pots, the *dudh karna*’s design puts the milk in the center of the burning fuel. The objective here appears to be to maximize the

TABLE 2. AVERAGE FUEL TEMPERATURES FROM CENTER OF HEARTH (°C)

TIME (min)	DUNG	WOOD	WOOD AND DUNG
0	36.7	38.6	41.0
5	366.4	601.1	780.9
10	472.8	592.7	739.2
15	715.1	620.1	688.4
20	608.1	640.3	638.1
25	645.4	700.6	775.5
30	621.2	728.9	752.4
35	613.3	728.9	752.4
40	610.4	652.7	783.4
45	611.3	701.3	759.5
50	599.0	611.3	755.0
55	591.2	685.1	674.9
60	600.6	691.7	656.0

fuel's energy. Because of buffalo dung's low cost in the region, Punjabis may use it for fuel wherever its properties prove efficient. While buffalo dung's surface remains cool, failing to produce a desirable flame for the *chulha* hearth type, burning dung produces high temperatures beneath its ash layer (Wright 1986, 1992). In a pile of burning buffalo-dung patties, heat is trapped in the center of the heap. The fuel burning experiments demonstrate that the temperatures from a hearth's center, using only dung as fuel, almost equals the temperatures produced by wood alone (Table 2). Thus, to maximize dung's heating capabilities, dung patties must surround the heated object, as done for milk containers in *dudh karnas*.

Kurahis

The *kurahi* stands as the final type of modern Punjab's domestic hearths (Fig. 5). This hearth uses a large bowl-shaped pan to pop seeds, such as barley, wheat, and corn, in sand instead of a flat pan to cook bread. The sand minimizes the searing of the seeds. After cooking, the pan's contents are poured through a screen to separate the popped-seeds from the sand. Though similar to the larger *chulhas* in size, shape, and fuel usage, the *kurahi* employs a semisubterranean construction. Fuel, normally chaff or leaves, is continuously resupplied through an opening below the pan. Like the *chulhas*, this hearth relies on a large flame to quickly cook the food.

DISCUSSION

The ethnographic data reveal some interesting trends concerning hearth morphology and function. First, the hearth's size directly relates to the size of the vessel used with it and the number of people fed. Second, different hearth types may utilize different fuels to conserve resources and best exploit particular fuel properties. Third, there is a correlation between hearth shape and function. The *chulha's* design allows the simultaneous efforts of heating and tending a pot. *Dudh*



Fig. 5. Semisubterranean *kurahi* used for cooking seeds in the sand.

karnas, on the other hand, incorporate designs that effectively encompass the heated vessel with dung fuel whose heat remains trapped in the hearth's center. Finally, *kurahis* are designed for holding the bowl-shaped pan used for popping seeds.

The next step is to see if any ethnographic trends, related to hearth morphology or function, are also visible in the archaeological record. But first it is critical to recognize and consider all the limitations of archaeological data. To begin with, hearth use in Pakistan today likely does not mirror that of 4500 years ago. For example, circular hearths used today to cook milk do not necessarily signify a similar use for Indus period circular hearths. Many problems also arise when trying to discern the depositional history of a hearth. It is difficult to ascertain whether a hearth's contents preserved in the archaeological record represent the culmination of all of its uses, the final cooking use of the hearth, or if they simply represent a later secondary trash deposit. Conceivably, hearths that go into disuse as cooking instruments could find new purpose as trash receptacles. Despite these problems, excavated hearths do possess many qualitative and quantifiable characteristics that may allow researchers to test whether patterns discovered through ethnographic observation are useful for the analysis of hearths in the archaeological record (e.g., Lowell 1995).

ARCHAEOLOGICAL STUDY

Archaeological hearth features possess many characteristics that allow comparison. Traits such as size, shape, construction material, and design permit archaeologists to trace hearth trends, as related to other cultural processes, through time and

TABLE 3. HARAPPAN CHRONOLOGY

PERIOD	PHASE	DATES
Period 5	Late Harappan phase (Cemetery H)	c. 1800–1700 B.C.
Period 4	Transitional	c. 1900–1800 B.C.
Period 3C	Harappan phase	c. 2200–1900 B.C.
Period 3B	Harappan phase	c. 2450–2200 B.C.
Period 3A	Harappan phase	c. 2600–2450 B.C.
Period 2	Harappan Transitional (Kot Diji)	c. 2800–2600 B.C.
Period 1	Early Harappan phase (Ravi)	c. 3300–2800 B.C.

space (Lowell 1995, 1999). This analysis represents an attempt to identify the relationship between Harappan hearth types and their contents. This will help determine the validity of using morphology for classifying hearths and establish a foundation for future hearth studies at Harappa.

Harappa

The site of Harappa provides an ideal setting for the study of hearths. Harappa persisted as a major metropolitan center of the Indus civilization, which flourished between 2600 and 1900 B.C. around the river valleys of the Indus and Ghaggar-Hakra rivers in South Asia (Table 3). Its continuous occupation through all the archaeologically recognized phases of the Indus civilization exhibits a complete evolution of hearths. Additionally, the expansiveness of this urban site provides an opportunity to study numerous examples of different hearth types. Located in the floodplain of the Ravi River, Harappa continues to provide invaluable data for Indus civilization researchers. In the past century and a half, this site has undergone several archaeological excavations (e.g., Cunningham 1875; Marshall 1931; Wheeler 1953, 1968). Most recently, the Harappan Archaeological Research Project directed multiple excavations between 1986 and 2001. During the past 15 years, project archaeologists excavated hundreds of hearths representing each period found at Harappa (Dales and Kenoyer 1990; Meadow and Kenoyer 1993; Meadow et al. 1995, 1996). Using this data, Kenoyer identified at least twenty ancient Harappan hearth varieties (pers. comm. 2001). Kenoyer based these type determinations on hearth size, shape, and construction features, such as presence of central columns or mud-brick walls.

For this study, 11 hearths were used from three rooms representing two separate Period 3A/B houses. While the excavators attribute residential use to these rooms on Harappa’s Mound E, the functional relationship of these rooms remains unclear (Meadow and Kenoyer 1993). The rooms date between 2300 and 2200 B.C. (Period 3B), and illustrate various characteristics (i.e., size, design, contents, and location) important for examining archaeological hearth features. Though multiple hearths occupy a single room, contemporaneous use for these hearths is questionable, and in some cases impossible as some were constructed above earlier, retired hearths. Still, each of these rooms possesses a variety of hearths, some of which share the same living floor.

Circular Hearths

With the exception of circular hearths, present-day Punjabis do not use hearth designs found at Indus sites. Within the three rooms, excavators removed a total of three circular hearths. The diameter of these hearths averaged between 35 and 40 cm with a depth of 10 to 15 cm. These dimensions are a little larger and slightly shallower than the typical *dudh karna* hearth observed in rural Pakistan today. Most contemporary Pakistanis place their *dudh karnas* against a courtyard or room wall. Two of the excavated Harappan circular hearths have similar placements. The third circular hearth, though, held a central location in one of the rooms. None of these circular hearths displayed evidence of specialized border construction. Rather, they existed as subterranean depressions. One circular hearth, however, possessed a few mud-brick fragments possibly belonging to a central column.

Ovoid Hearths

Another archaeological hearth type found in these rooms has an ovoid shape. In the rooms sampled, excavators discovered four hearths with this shape. The dimensions of these hearths varied greatly. Their widths ranged from 85 to 130 cm while their lengths varied between 45 and 60 cm. The depths of these hearths appeared a little more consistent, ranging from 30 to 40 cm. Three of these hearths had a clay-lined base and two contained mud-brick central columns.

Rectangular Hearths

The third hearth type found in the study area is rectangular in shape. Like the ovoid-shaped hearths, the dimensions for this type also fluctuate severely. The width of the four rectangle hearths ranges from 60 to 100 cm, the length from 45 to 80 cm, and the depth from 15 to 40 cm. Two of the four rectangular hearths contain central columns. These two also have clay-lined borders and a depth about half that of the two hearths without central columns. The hearths without central columns are unique in that their borders consist of mud-brick and baked brick. These wall features may provide insight into the hearth's function. Though these wall features may be purely stylistic, they may represent extensive hearth utilization requiring sturdier construction. Their use may also relate to cooking vessel support.

Central Columns

Central columns sometimes occur in each of the three types of Harappan hearths (circular, ovoid, and rectangular). While modern Punjabi hearths lack central columns, these features are present in hearths in Gujarat, India (Richard Meadow, pers. comm. 2000). Like the mud-plastered walls of a *chullha*, the central column in these Gujarati hearths serves to help support the cooking vessel over the flame. If this was the purpose of the central column in ancient Harappan hearths, then the presence of a column reflects a specific aspect of hearth function. If a circular hearth has a central column, this may indicate that the heated object was not placed directly into the fire, but instead positioned above the flame. Thus, a cir-

cular hearth with a central column functions differently from one without and should be categorized as such. This implies that hearths with central columns and hearths without should be considered as separate types. Consequently, the number of hearth types found in the sampled rooms doubles from three to six (circular, circular with central column, rectangular, rectangular with central column, ovoid, and ovoid with central column). This typology, identical to the one employed by Meadow and Kenoyer (1993), does not presuppose that shape dictates function for archaeological hearths. While the ethnographic evidence demonstrates that morphology can play a role in hearth use, archaeological hearth function can be studied through the examination of hearth contents and associated artifacts. For the time being, however, shape serves as an adequate starting point for comparisons of archaeological hearth contents. Future research, though, may allow classification of archaeological hearths by function rather than shape, as done with the ethnographic hearth examples.

Harappan Hearth Analysis

Determining the validity of using hearth morphology for Harappan hearth classification systems requires examination of hearth contents. As mentioned earlier, the depositional history of hearths may often be questionable, but regardless of how and why some materials find their way into these features, hearths can often be counted on to yield artifacts such as pottery, lithics, and faunal material. The hearths used in this study also produced these kinds of materials. Researchers of the Harappan Archaeological Research Project will analyze terracotta fragments, animal bone, steatite beads, and chert flakes from these hearths as part of a larger study of Harappan cultural and subsistence practices. Excavators found all of these items in the charcoal or ash layers of hearths. These artifacts probably reflect original hearth use and may have been processed or manufactured by fire.

In general, each investigated hearth held similar numbers of each artifact type. This data may demonstrate the lack of distinctions between archaeological hearth types. Without considering other data, this suggests that Harappan hearth morphology has no relationship to hearth artifact content. Future studies could benefit from the examination of artifacts that are associated with hearths, but that lie outside hearth boundaries. For example, these studies could reveal a correlation between hearth types and certain pottery styles or occupational trade items.

Hearths also contain considerable amounts of charred plant material that are very useful for contextual analysis. This common archaeological material is often found in large quantities in Harappan hearths. For this study, each hearth possessed an ash-charred plant fill that was distinct from ordinary occupational debris (Mark Kenoyer, pers. comm. 2000). Where available, 9-liter samples were removed from each of the excavated Harappa hearths for flotation. If the hearth did not hold 9 liters, the entire hearth was removed as a sample. The charred plant remains recovered from flotation were sifted through a 0.5 mm mesh. Materials larger than 0.5 mm were separated into seeds, wood charcoal, and other identifiable material (e.g., bone, shell, lithics, and modern debris). Since 1986, archaeobotanists have accumulated more than 10,000 charred Harappan seeds through this process. Once identified, researchers measured the materials by volume and weight.

TABLE 4. HEARTH SHAPE AND PALAEOBOTANICAL MATERIAL

HEARTH #	SHAPE	CHARCOAL	SEEDS	TOTAL	DIFFERENCE	SEED %	CHARCOAL %
28	Rectangular	2.30	6.93	9.23	-4.63	75.1	24.9
162	Rectangular	0.34	0.14	0.48	0.20	29.7	70.3
70	Circular with central column*	0.04	0.02	0.05	0.02	28.9	71.1
90	Circular	0.08	0.03	0.17	0.05	28.3	71.7
233	Circular	0.24	0.05	0.29	0.19	17.8	82.2
7	Ovoid with central column	0.04	0.02	0.05	0.02	28.9	71.1
210	Ovoid with central column	5.79	0.37	6.17	5.42	6.0	94.0
69	Ovoid**	0.43	0.03	0.45	0.40	5.8	94.2
70A	Rectangular with central column	1.32	0.04	1.36	1.27	3.3	96.7
16	Rectangular with central column	1.40	0.04	1.43	1.36	2.5	97.5
25	Ovoid with central column	30.47	0.06	30.53	30.41	0.2	99.8

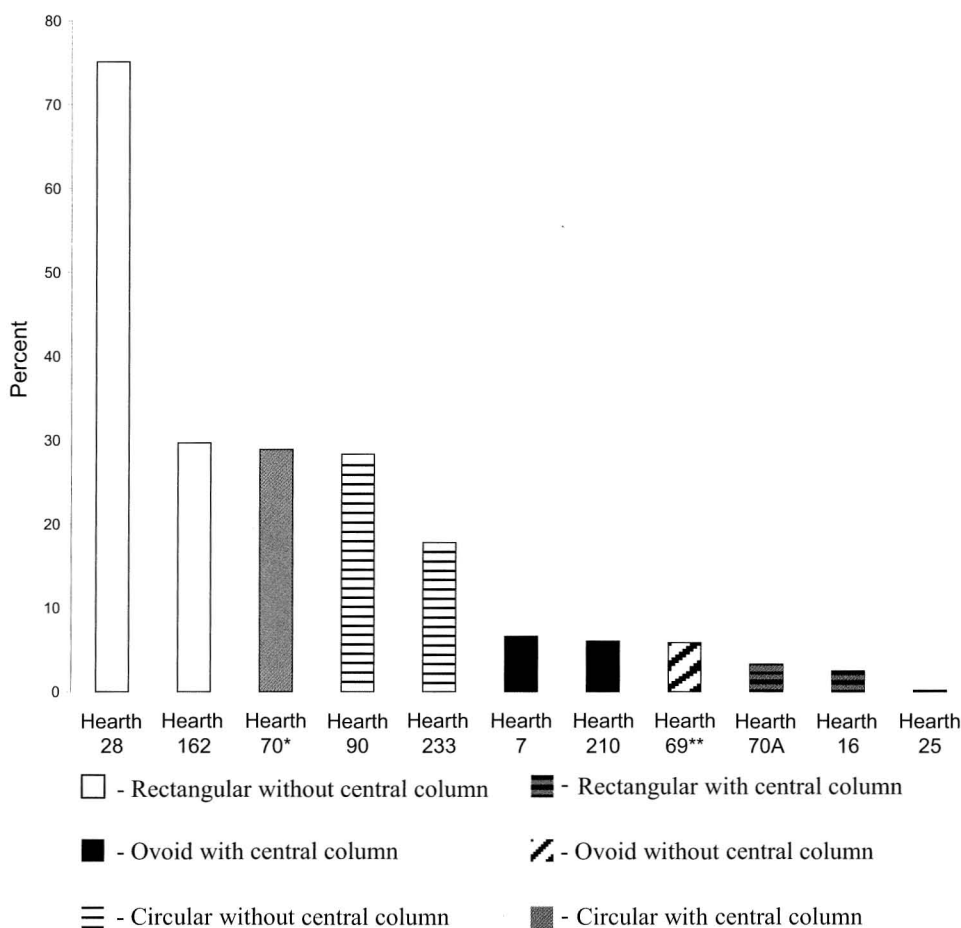
*Hearth 70 may not have a central column.

**Hearth 69 may have a central column.

The archaeobotanical materials used in this study come from hearths excavated by members of the Harappan Archaeological Research Project during the 1993 field season. The guidelines for this project required that excavators remove 9 liters of sediment from each hearth for palaeobotanical study (Miller 1992). Since all of the hearths used in this study had volumes greater than 12 liters, excavators should have extracted 9 liters of sediment from each hearth. If excavators followed this procedure, it should be easy to calculate seed and wood charcoal densities. Unfortunately, the exact sediment volumes removed from each hearth for flotation are unavailable; therefore, it would be inappropriate to compare hearths using densities. Instead, weight percentages are used in this study to compare seeds (including seed fragments) and wood charcoal found in the hearths (Table 4). This should be sufficient to illustrate variability in Harappan hearth content according to morphological type. Future studies focused on determining hearth function would do well to use seed and wood charcoal densities.

The results in Table 4 show that hearths of the same type generally have similar seed and wood charcoal percentages (Fig. 6). The rectangular Hearth 28 without a central column produced a much higher percentage of seeds per sample than any other type of hearth. This result may be due to the hearth's location rather than its morphology. Hearth 28 lies near the border of one of the Harappan rooms and excavations did not conclusively determine whether the hearth operated inside or outside of the structure. This observation points to the importance of future comparative analyses of interior and exterior hearth contexts. However, the other rectangular hearth lacking a central column (Hearth 162) also had a relatively high percentage of seeds. Only circular hearths had seed percentages per sample as high as either of these two rectangular hearths.

Two of the circular hearths also lack a central column. Hearth 70 showed evidence of a central column. However, its seed/wood charcoal ratio was similar to that of the other circular hearths. The basis for defining the central column in

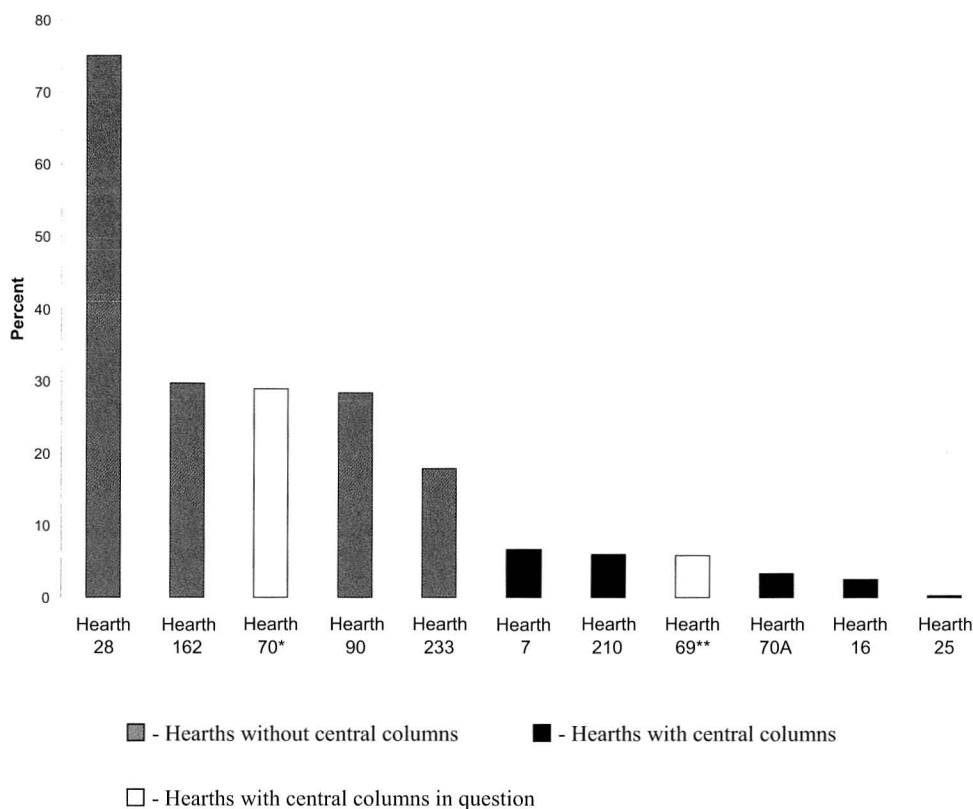


*Hearth 70 may not have a central column. **Hearth 69 may have a central column.

Fig. 6. Percentage of hearth seed content in relation to charcoal.

this hearth was the presence of a few mud-brick pieces in the hearth's center (Meadow and Kenoyer 1993). It is very likely that these pieces do not represent a central column. The fact that no other circular hearths at Harappa have been found to possess central columns supports this position (Kenoyer, pers. comm. 2001). Until archaeologists find additional circular hearths with central columns, Hearth 70's legitimacy remains in question.

In general, the hearth types with central columns yielded seed ratios much lower than those seen for other hearth types. In none of the rectangular or ovoid hearths with a central column did the percentage of seeds exceed 10 percent of the total seed/wood charcoal content. Excavations could not conclusively determine whether the ovoid Hearth 69 possessed a central column. Archaeobotanical studies, however, may someday be able to assist hearth classification where certain qualitative hearth properties remain blurred following excavation. For example,



*Hearth 70 may not have a central column. **Hearth 69 may have a central column.

Fig. 7. Percentage of seed content for hearths with and without central columns.

these results might suggest that Hearth 69 did possess a central column, as its archaeobotanical contents appear virtually indistinguishable from the other ovoid hearths that do possess a central column. If Hearth 69 did possess a central column and Hearth 70 did not, a real distinction in hearth content is seen for hearths with and without central columns (Fig. 7).

Seed Identification

The results from the seed identification from each hearth offer little assistance for hearth comparisons. Identified seed counts are similar for all of these hearths (Table 5), but statistical comparisons are difficult due to the low number of seeds identified using 40 \times magnification. Seed fragments (not shown on Table 5), however, make up the bulk of the seed content for each hearth. Under 40 \times magnification, seed fragments are distinguished easily from wood charcoal, but determining genus, or even family, is more difficult. Most of these seed fragments are likely wheat and barley. If these fragments can be identified, using electron

TABLE 5. SEED IDENTIFICATION

HEARTH #	SHAPE	TRITICUM	HORDEUM	OTHER	TOTAL SEEDS
28	Rectangular	19	19	4 <i>Avena</i> 1 <i>Trianthema</i> 2 Caryophyllaceae 2 Fabaceae (<i>Trifolium?</i>) 8 unknown	55
162	Rectangular	2	—	1 Caryophyllaceae 1 unknown	4
70	Circular with central column*	—	—	1 unknown	1
90	Circular	—	—	1 unknown	1
233	Circular	2	—	1 Fabaceae (<i>Trifolium?</i>)	3
7	Ovoid with central column	7	6	56 unknown	69
210	Ovoid with central column	5	5	1 <i>Chenopodium</i> 3 Caryophyllaceae 7 Cyperaceae? 8 unknown	29
69	Ovoid**	—	—	—	0
70A	Rectangular with central column	—	2	1 <i>Chenopodium</i>	3
16	Rectangular with central column	—	—	1 <i>Chenopodium</i> 7 unknown	8
25	Ovoid with central column	—	—	1 Caryophyllaceae 1 unknown	2

*Hearth 70 may not have a central column.
**Hearth 69 may have a central column.

scanning microscopes or other technologies, they should contribute further to determining the usage of Harappan hearths.

The presence of weedy seeds, or their absence, may hold valuable clues to ascertaining the type of fuel used in these hearths. If weedy seeds can be understood to indicate dung use as fuel (Bottema 1984; Miller 1984; Miller and Smart 1984), their absence, in conjunction with the observation that the majority of the archaeobotanical material in all of the hearths (except for Hearth 28) is wood charcoal, suggests that the ancient Harappans did not use dung in their hearths. This could indicate a change in resource availability. Either accessibility to wood decreased from Harappan to modern times or dung use as fuel has increased since the Harappan period. However, such inferences need to be considered carefully. The seeds of non-weedy plants (e.g., wheat and barley) included in dung patties (either as temper or animal ingestion) could also represent dung use for fuel (Reddy 1999). If this is the case, Hearth 28, with its high percentage of cereal seeds, may have used a dung fire. Future studies using a larger sample size could greatly elucidate this situation.

Here again, hearth morphology may assist interpretations of hearth contents. This study suggests that Harappan hearths without central columns have higher levels of seeds than hearths displaying central columns. In contemporary Punjabi hearth use, objects heated using dung fuel are placed directly on the fire. Thus, modern hearths incorporating dung fuel are not designed to suspend the heated

object far from the fuel itself. If Harappan hearth builders also followed this design pattern, dung-fueled hearths (if they existed) would not have central columns, or other contraptions, to hold objects over the fuel. Therefore, if high seed content reflects dung use, it would not be surprising to find low seed content in hearths with central columns, where dung fires would not be as effective in heating suspended objects. Additionally, identification of wood charcoal should provide information about the types of wood used for fuel during successive Harappan periods.

Changes in wood use may reflect environmental shifts. Specific wood types may also prove to have a relationship with certain hearth types. For example, indoor hearths might burn wood that produces less smoke (Sobolik et al. 1997). Other cultural characteristics, such as status and occupation, may be a factor in the use of wood as a fuel. Obviously, this avenue of research holds much potential for understanding Harappan hearth use.

CONCLUSION

Ethnographic data from the Punjab region of Pakistan empirically demonstrates that different hearth types have specific functions. This analysis examined the validity of the hearth typology based on morphology, in place at Harappa. This site possesses several archaeological hearth types that yield different percentages of seeds in relation to wood charcoal according to morphological type. If hearth content and morphology reflect function, these results could suggest that ancient Harappans designed hearths for particular functions. By identifying differences in hearth content in accordance with hearth morphology, this study represents a first step in deciphering archaeological hearth function at Harappa. With the identification of function, a more accurate classification of Harappan hearths becomes possible. Ultimately, this type of research should provide better insight into the cultural tendencies (i.e., consumption practices, cooking techniques, and resource conservation habits) of the Harappan people.

The examination of eleven hearths in three Period 3B Harappan rooms, demonstrates a clear difference between the contents of hearths with central columns and hearths that do not have central columns. Further sampling should reveal additional distinctions between archaeological hearth types. This information, along with ethnographic and experimental research, will help develop a classification system for hearths that more accurately represents hearth function. For example, hearths that hold the cooking vessel above the flame, such as *chulhas* or hearths with central columns, may be placed in a category marked by well-defined walls, the use of wood or a wood/dung combination for fuel and a low expectancy rate for crop seeds.

When interpreting hearth function, palaeoethnobotanical materials may prove the most valuable due to their abundance compared to other archaeological materials. This abundance allows statistical comparisons between hearths using a satisfactory sample size. Finding varying percentages of seeds and wood charcoal according to hearth type suggests that the ancient Harappans used certain hearths differently than others, and that differences in construction were not purely ornamental. These preliminary results show certain easily recognizable trends. It seems that the ancient Harappans had a variety of hearths for a variety of different pur-

poses just as is seen in contemporary Punjabi homes. Not all hearths are alike and only through careful analysis can we determine their usage.

ACKNOWLEDGMENTS

I would like to thank Dr. Steven Weber for his assistance throughout this process. I am indebted to the members of the Harappa Archaeological Research Project, especially Dr. Mark Kenoyer and Dr. Richard Meadow, for making available the data necessary for this project and for kindly offering advice as necessary. I would also like to thank Susan Ellis for her assistance in the analysis portion of this project. Finally, I am grateful to Peter Johansen, Namita Sugandhi, and two anonymous reviewers whose comments have substantially improved this paper.

REFERENCES CITED

- BELCHER, W.
1998 Fish Exploitation of the Baluchistan and Indus Valley Traditions: An Ethnoarchaeological Approach to the Study of Fish Remains. Ph.D. diss. University of Wisconsin–Madison, Madison.
- BINFORD, L. R.
1967 Smudge pits and hide smoking: The use of analogy in archaeological reasoning. *American Antiquity* 29:435–441.
1981 *Bones: Ancient Man and Modern Myths*. New York: Academic Press.
- BISHT, R. S.
1982 Excavations at Banawali: 1974–1977, in *Harappan Civilization: A Contemporary Perspective*: 113–124, ed. G. L. Possell. Warminster, England: Aris and Phillips Ltd.
- BOTTEMA, S.
1984 The composition of modern charred seed assemblages, in *Plants and Ancient Man*: 207–212, ed. W. Van Zeist and W. A. Casparie. Rotterdam: Balkena.
- CUNNINGHAM, A.
1875 Harappa. *Archaeological Survey, Report 1872–73*.
- DALES, G., AND J. M. KENOYER
1990 *Preliminary Report on the Fifth Season at Harappa, Pakistan, January 1–March 31, 1990*. Berkely and Madison: University of California–Berkeley and University of Wisconsin–Madison.
- DAVID, N., AND C. KRAMER
2001 *Ethnoarchaeology in Action*. Cambridge: Cambridge University Press.
- HODDER, I.
1982 *The Present Past*. London: B. T. Batsford.
- KAJALE, M. D.
1991 Current status of Indian palaeoethnobotany: Introduced and indigenous food plants with a discussion of the historical and evolutionary development of Indian agriculture and agricultural systems in general, in *New Light of Early Farming*: 155–189, ed. J. M. Renfrew. Edinburgh: Edinburgh University Press.
- KENOYER, J. M.
1998 *Ancient Cities of the Indus Valley Civilization*. New York: American Institute of Pakistan Studies.
- LOWELL, J.
1995 Illuminating fire-feature variability in the Grasshopper region of Arizona. *Kiva* 60(3):351–369.
1999 The fires of Grasshopper: Enlightening transformations in subsistence practices through fire-feature analysis. *Journal of Anthropological Archaeology* 18:441–470.
- MARSHAL, J. H.
1931 *Mohenjo-daro and the Indus Civilization*. London: Probsthain.

- MEADOW, R., AND J. M. KENOYER
 1993 Harappa Archaeological Research Project: Harappa excavations 1993. Report submitted to the Director-General of Archaeology and Museums, Government of Pakistan, Karachi.
- MEADOW, R., J. M. KENOYER, AND R. WRIGHT
 1995 Harappa Archaeological Research Project: Harappa Excavations 1994 and 1995. Report submitted to the Director-General of Archaeology and Museums, Government of Pakistan, Karachi.
 1996 Harappa Archaeological Research Project: Harappa excavations 1996. Report submitted to the Director-General of Archaeology and Museums, Government of Pakistan, Karachi.
- MEYER, J. C.
 2001 Harappan hearth variability. M.A. thesis. Washington State University, Pullman.
- MILLER, H.M.L.
 1992 Flotation at Harappa: Procedures and problems. Unpublished report, Harappa Archaeological Research Project files, Harappa, Pakistan.
- MILLER, N. F.
 1984 The use of dung as fuel: An ethnographic example and an archaeological application. *Paléorient* 10(2):71-79.
- MILLER, N. F., AND T. L. SMART
 1984 Intentional burning of dung as fuel: A mechanism for the incorporation of charred seeds into the archeological record. *Journal of Ethnobiology* 4(1):15-28.
- REDDY, S. N.
 1991 On the banks of the river: Opportunistic cultivation in South India. *Expedition* 33(3):18-26.
 1994 Plant Usage and Subsistence Modeling: An Ethnoarchaeological Approach to the Late Harappan of Northwest India. Ph.D. diss. University of Wisconsin-Madison.
 1997 If the threshing floor could talk: Integration of agriculture and pastoralism during the Late Harappan in Gujarat, India. *Journal of Anthropological Archaeology* 16:162-187.
 1999 Fueling the hearths in India: The role of dung in paleoethnobotanical interpretation. *Paléorient* 24(2):61-70.
- SOBOLIK, K. D., L. S. ZIMMERMAN, AND B. M. GUILFOYL
 1997 Indoor versus outdoor firepit usage: A case study from the Mimbres. *Kiva* 62(3):283-300.
- THIEBAULT, S.
 1988 Palaeoenvironment and ancient vegetation of Baluchistan based on charcoal analysis of archaeological sites. *Proceedings of Indian National Science Academy* 54a(3):501-509.
- WEBER, S.
 1993 Changes in plant use at Rojdi: Implications for early South Asian subsistence systems, in *Harappan Civilization*: 287-293, ed. Gregory Possehl. Oxford: Oxford and IBH Press.
- WHEELER, M.
 1958 *The Indus Civilization*. Cambridge: Cambridge University Press.
 1968 *The Indus Civilization: Supplementary Volume to the Cambridge History of India*. Cambridge: Cambridge University Press.
- WRIGHT, M.
 1986 Le Bois de Vache: This chip's for you. *Saskatchewan Archaeology* 7:25-28.
 1992 Le Bois de Vache II: This chip's for you too, in *Alberta: Studies in the Arts and Sciences* 3(2):225-244, ed. J. Foster and D. Harrison. Alberta: The University of Alberta Press.

ABSTRACT

Hearth features possess potential for providing valuable archaeological data on past cooking and heating practices. Ethnographic study demonstrates a relationship between hearth morphology and function in rural Punjabi homes. Preliminary work from the nearby Indus civilization site of Harappa suggests a relationship between hearth content and morphology. If hearth contents reflect hearth function, future research may provide further insight on archaeological hearth use in conjunction with hearth type. **KEYWORDS:** Indus civilization, Harappa, hearth features, ethnoarchaeology, experimental archaeology, palaeoethnobotany.